# Secondary Markets in Turbulent Times: Distortions, Disruptions and Bailouts

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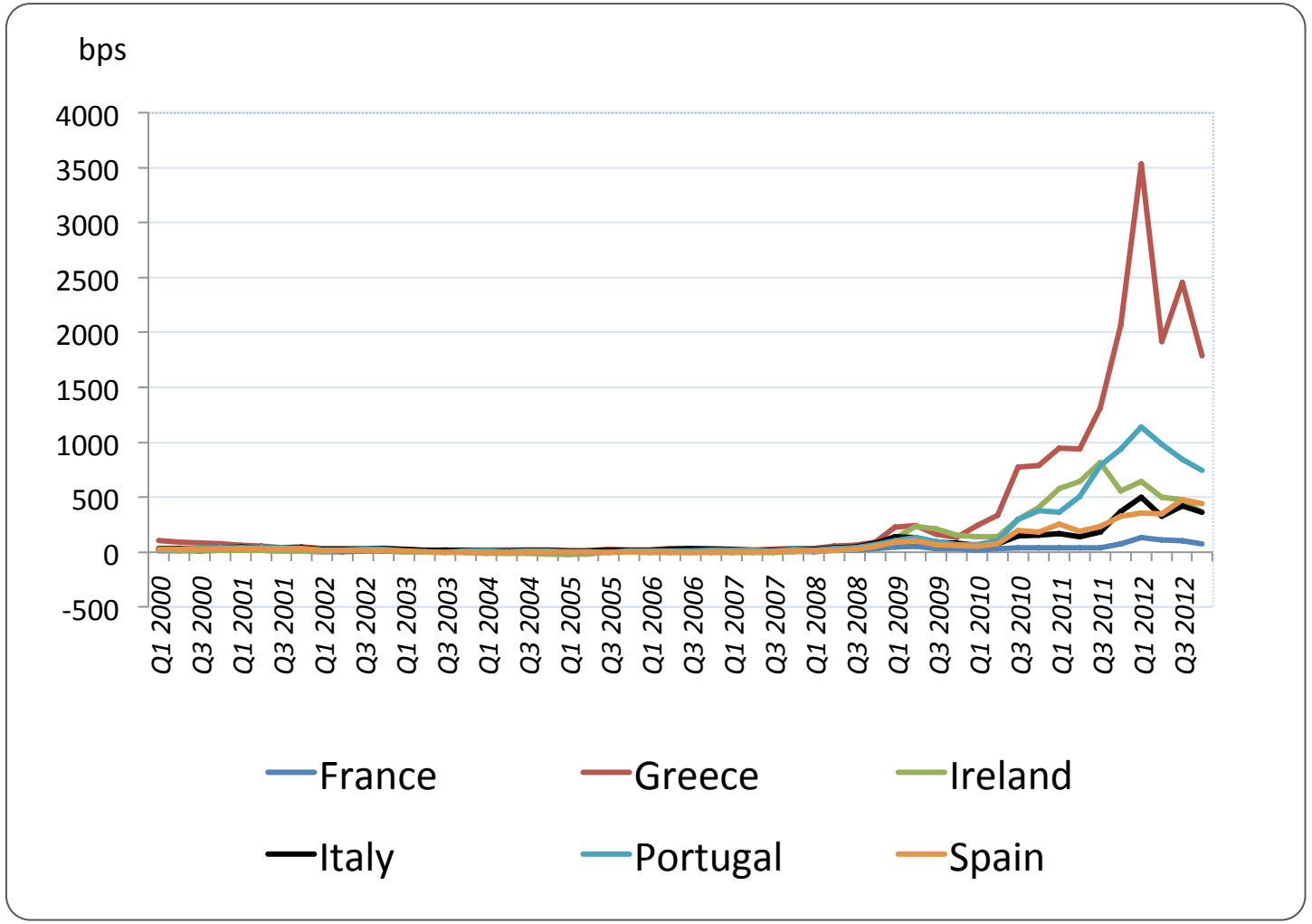
## Motivation

- In 2006, Portugal, Ireland, Italy, Greece, and Spain looked very solid
  - growth: 3.7% (Germany and France 2.8%)
  - fiscal deficit/GDP: 1.8% (Germany and France 2.0%)
  - sovereign spreads: 0.15%
  - public debt/GDP: 77% (Germany and France 71%)
  - maturity: 6.4 years (Germany and France 6.6 years)
- By 2010, PIIGS were facing
  - major sovereign debt problems
  - deep recessions
- What happened?

# Sovereign spreads



## Motivation

- Explanations
  - ignored problems: fiscal in Greece, low growth in Portugal and Italy, bubbles in Ireland and Spain
    - ex-post rationalization? why ignored for so long?
  - rollover/liquidity crises
    - but debts were long term and there is funding from official creditors

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- This paper
  - secondary markets and multiple equilibria
  - foreigners become pessimistic $\longrightarrow$ sell bonds to domestics $\longrightarrow$ crowds out investment $\longrightarrow$
    $\longrightarrow$ lower growth $\longrightarrow$ lower cost of default $\longrightarrow$ default more likely $\longrightarrow$ validates pessimism

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- Crucial assumptions
  - governments sometimes discriminate in favor of domestic residents
  - cost of default depends on size of economy
  - secondary markets

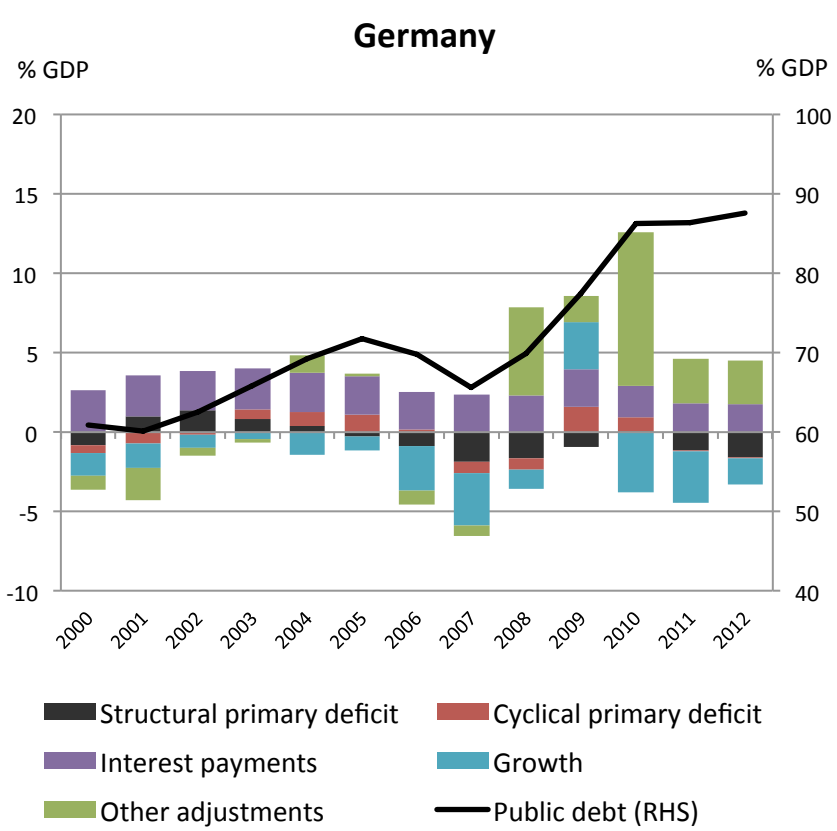
## Related literature

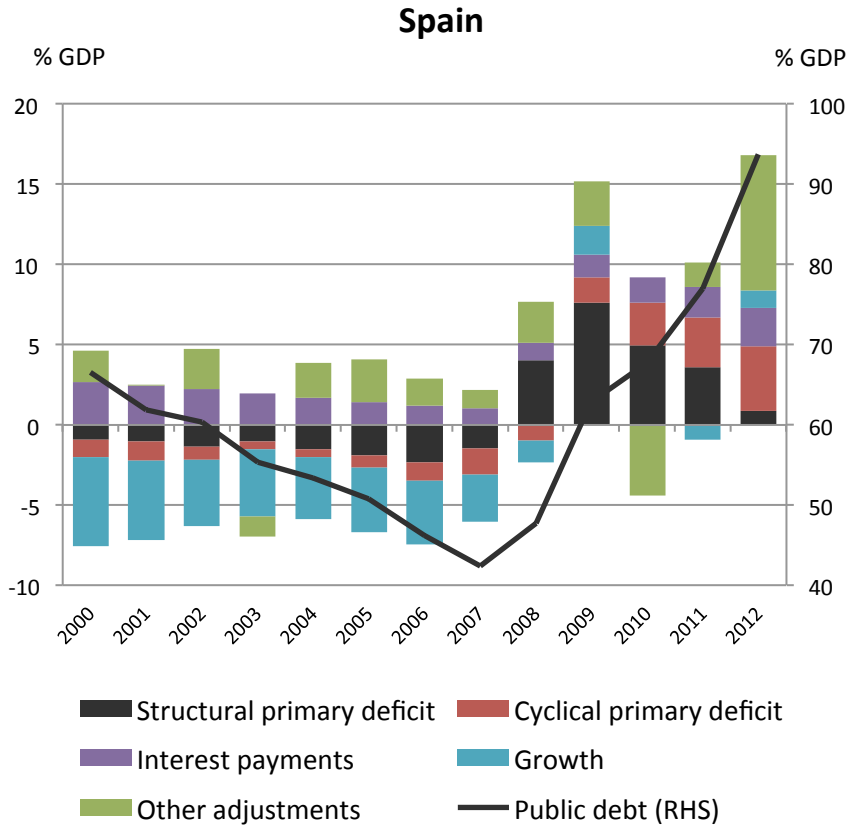
- Self-fulfilling debt crises
  - Calvo (1988), Cole-Kehoe (2000), Conesa-Kehoe (2012), Aguiar-Amador-Farhi-Gopinath (2013)
- Secondary markets and sovereign risk
  - Broner-Martin-Ventura (2008, 2010), Broner-Ventura (2010, 2011), Lanau (2011), Bai-Zhang (2012), Pitchford-Wright (forth.)
- Sovereign defaults and economic activity
  - Aguiar-Amador-Gopinath (2009), Aguiar-Amador (2011), Brutti (2011), Erce (2012), Mendoza-Yue (2012), Mengus (2012), Gennaioli-Martin-Rossi (forth.)
- Gross capital flows during crises
  - Broner-Didier-Erce-Schmukler (2013), Brutti-Saure (2013)

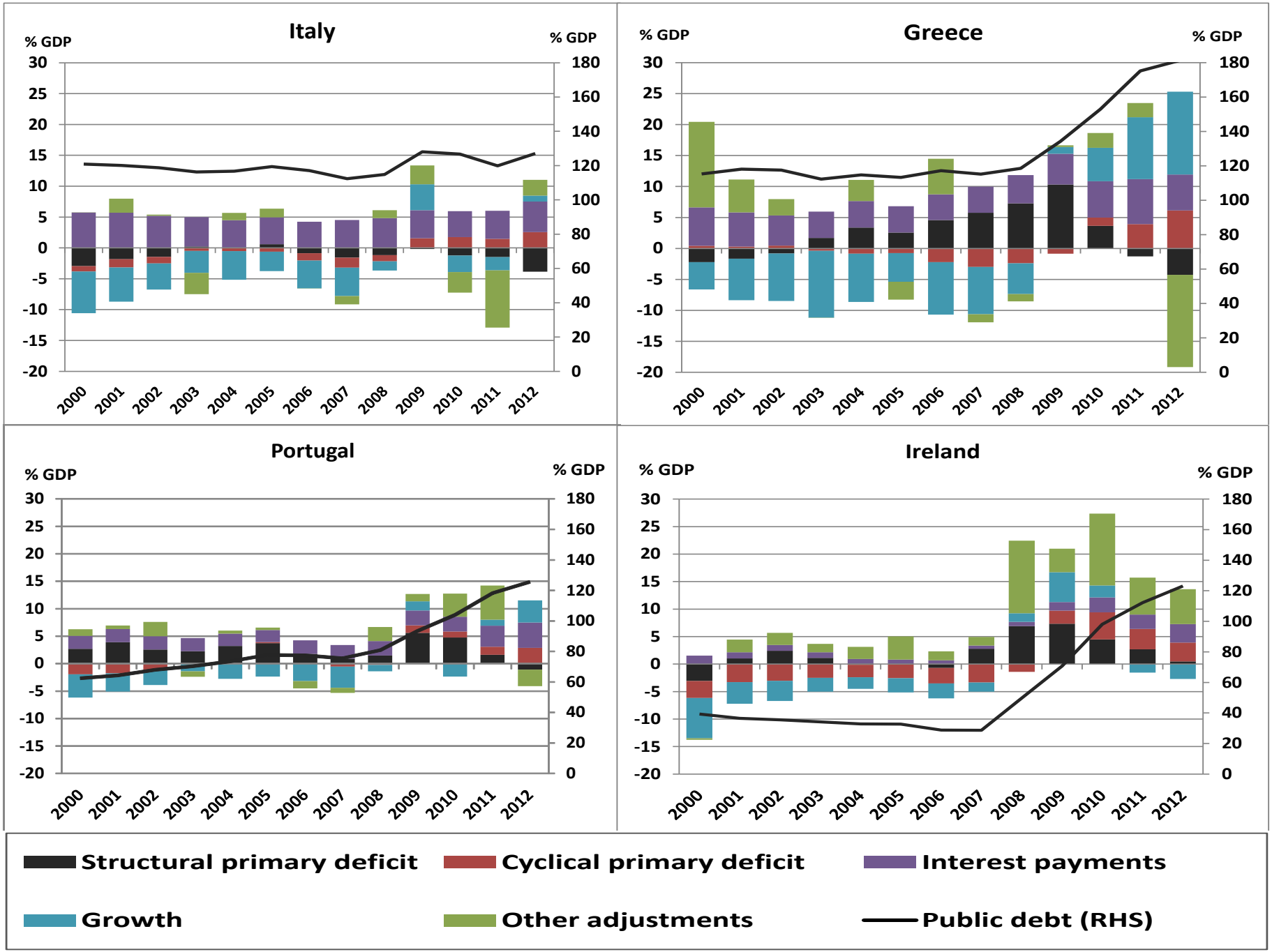
## Some facts

- Dynamics of Debt-GDP ratios
  - sources: OECD's Economic Outlook Database, Eurostat
  - in PIIGS driven by high spreads, low growth, and high cyclical deficits, despite low structural deficits
  - in Germany driven bank recapitalization

# Debts and Deficits: Germany vs. Spain




Italy
% GDP
% GDP
Greece
% GDP
% GDP
Portugal
% GDP
% GDP
Ireland
% GDP
% GDP
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Structural primary deficit
Cyclical primary deficit
Interest payments
Growth
Other adjustments
Public debt (RHS)

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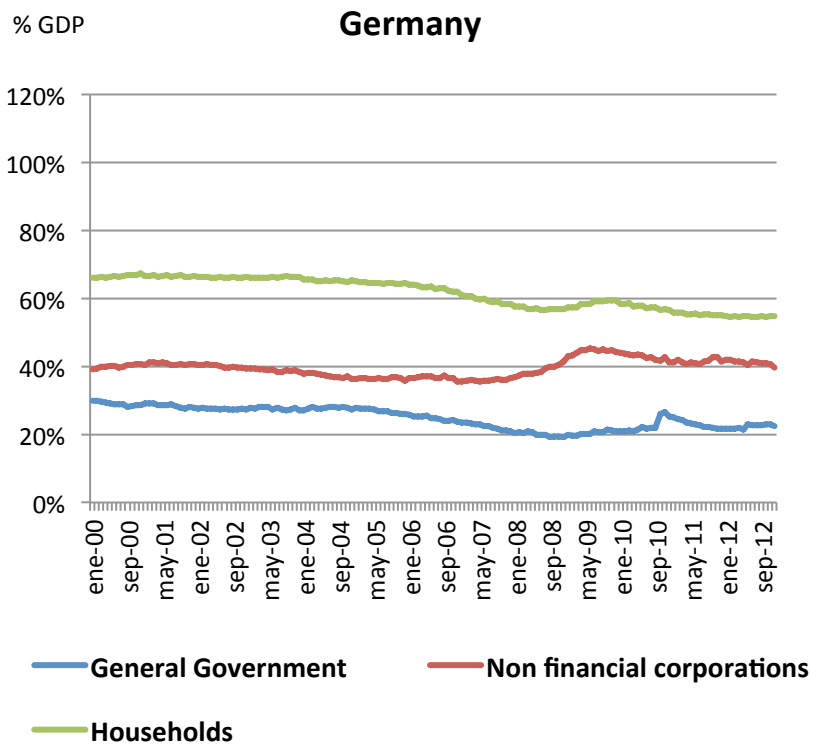
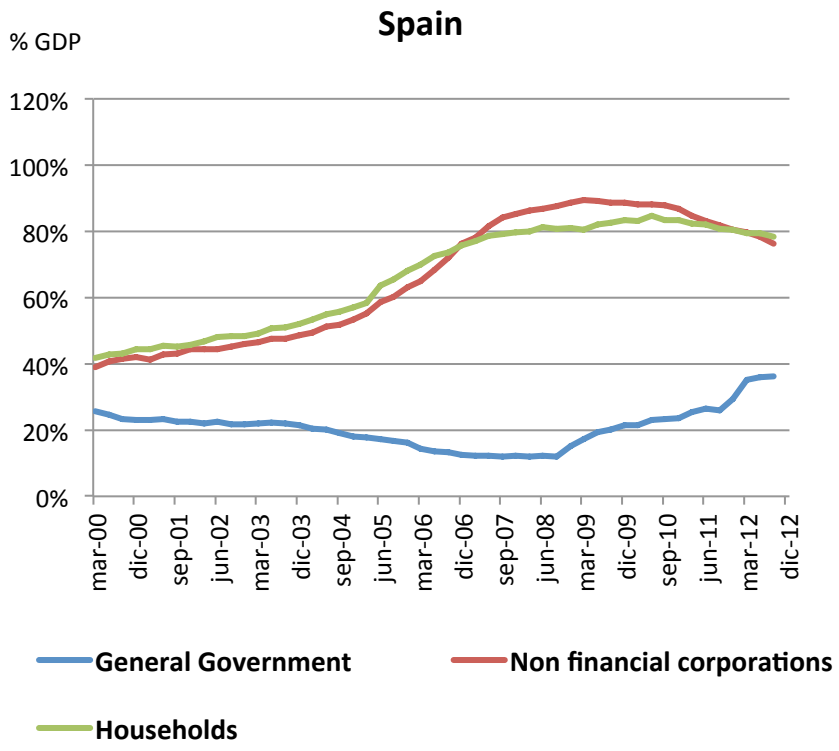
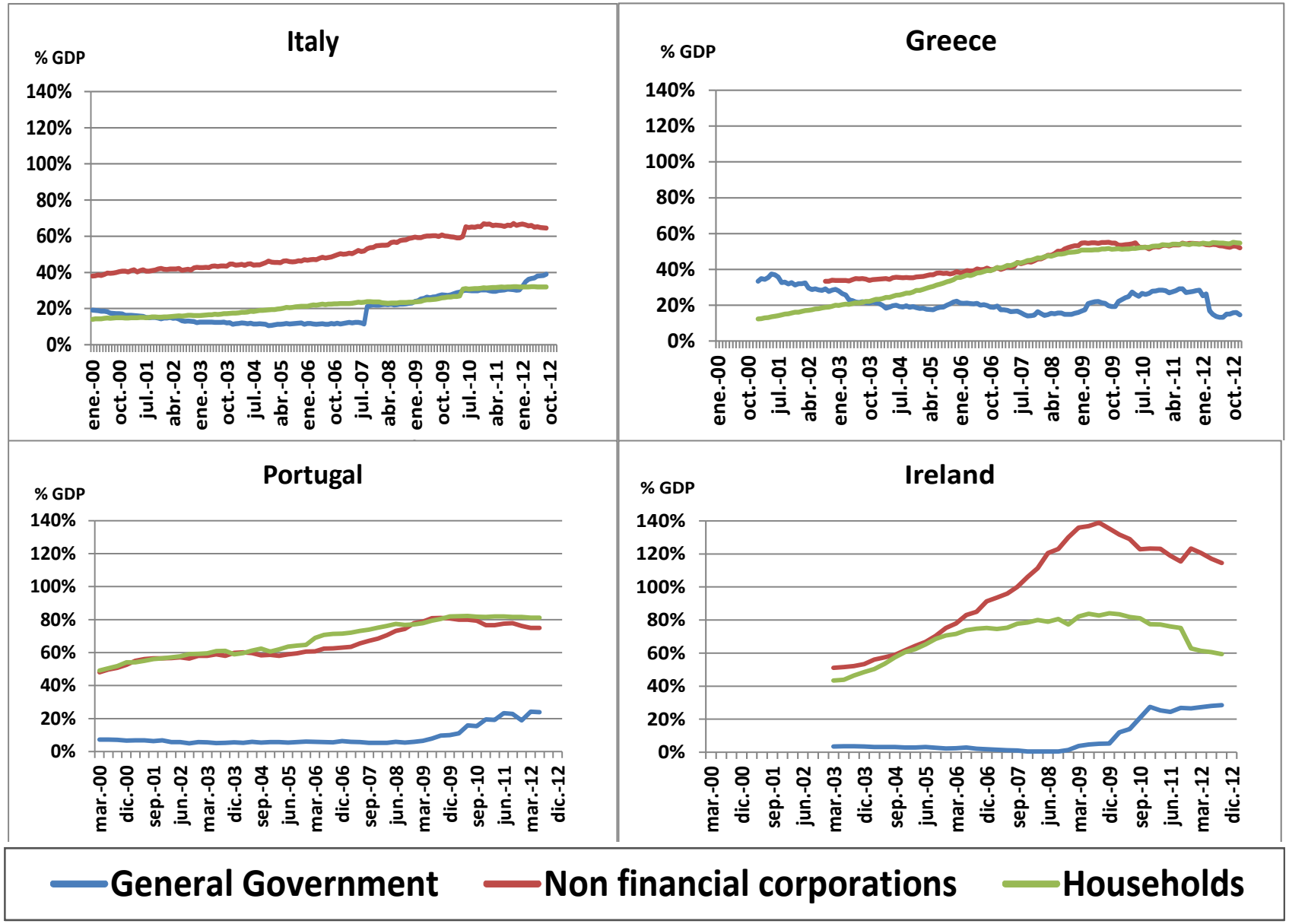
- Domestic credit allocation
  - sources: National Central Banks' Monetary Surveys and Financial Accounts, Datastream
  - in PIIGS credit to government increased while credit to corporations and households decreased
  - in Germany they have been flat

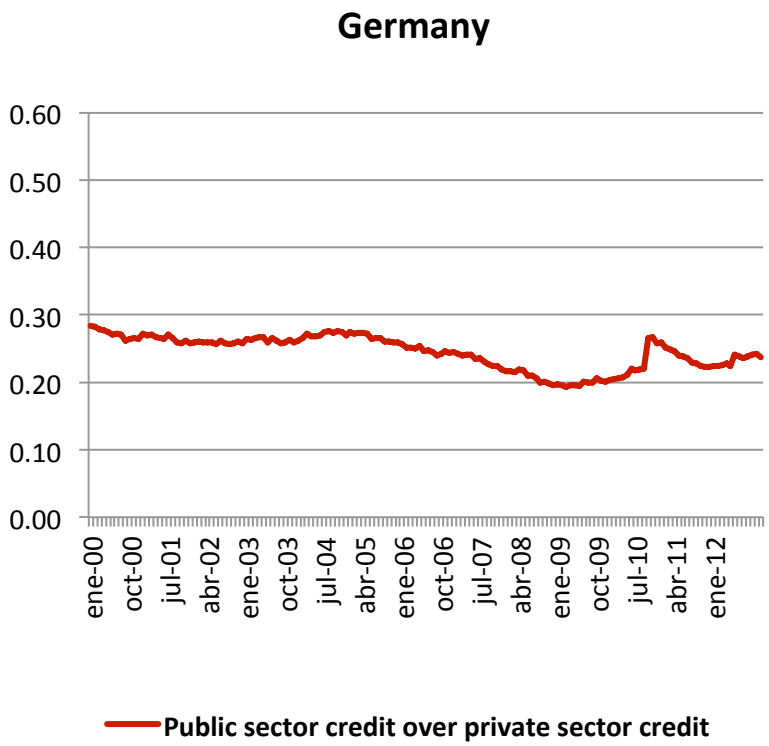
# Sectorial credit: Germany vs. Spain

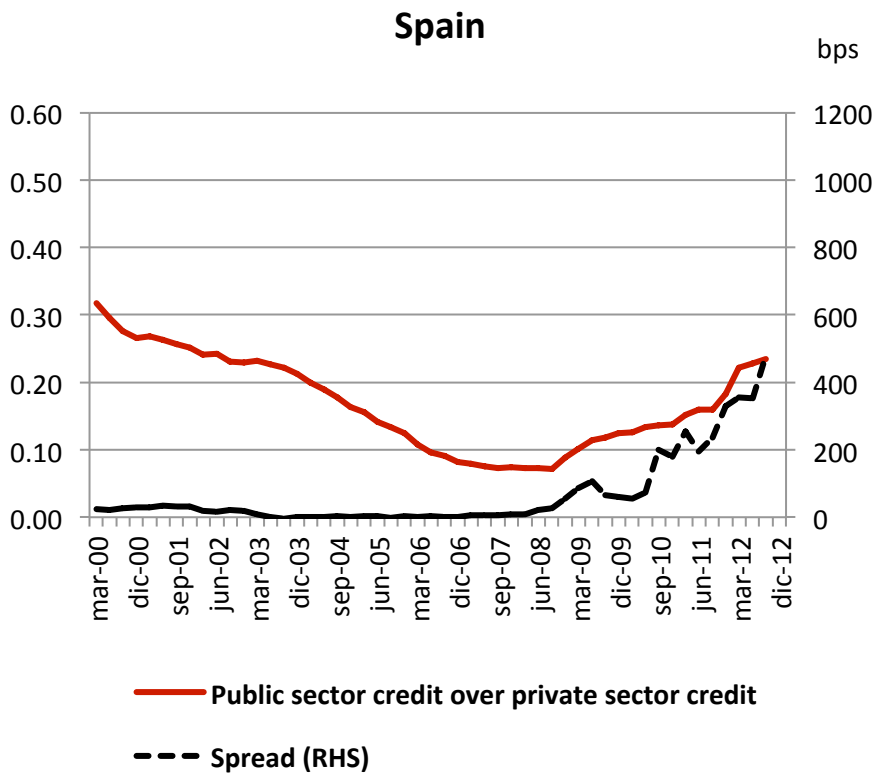


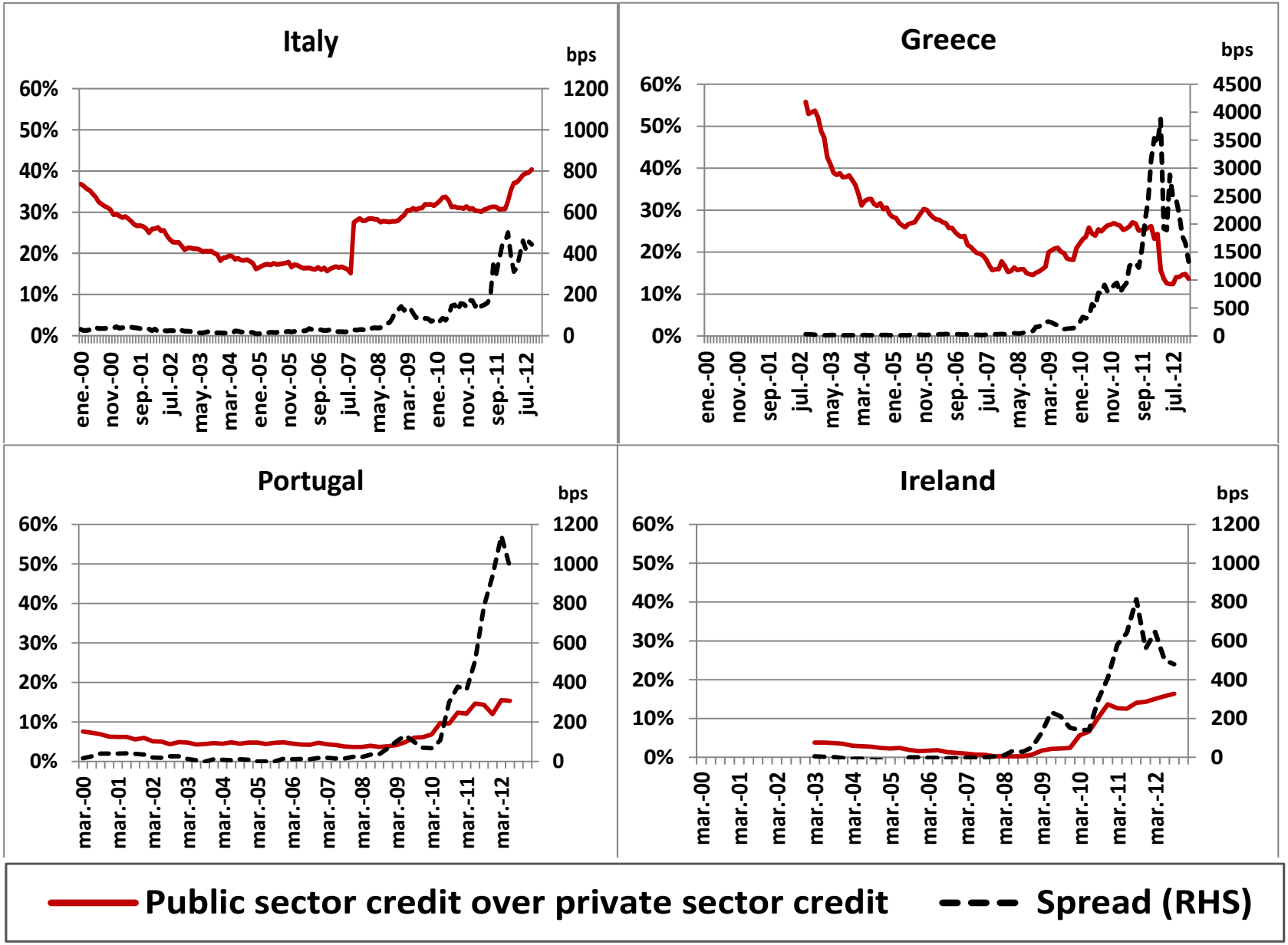




Italy
% GDP
140%
120%
100%
80%
60%
40%
20%
0%
ene.-00
oct.-00
jul.-01
abr.-02
ene.-03
oct.-03
jul.-04
abr.-05
ene.-06
oct.-06
jul.-07
abr.-08
ene.-09
oct.-09
jul.-10
abr.-11
ene.-12
oct.-12
Greece
% GDP
Portugal
% GDP
mar.-00
dic.-00
sep.-01
jun.-02
mar.-03
dic.-03
sep.-04
jun.-05
mar.-06
dic.-06
sep.-07
jun.-08
mar.-09
dic.-09
sep.-10
jun.-11
mar.-12
dic.-12
Ireland
% GDP
General Government
Non financial corporations
Households

# Public credit, private credit & sovereign spreads




Italy
bps
60%
50%
40%
30%
20%
10%
0%
1200
1000
800
600
400
200
0
ene.-00
nov.-00
sep.-01
jul.-02
may.-03
mar.-04
ene.-05
nov.-05
sep.-06
jul.-07
may.-08
mar.-09
ene.-10
nov.-10
sep.-11
jul.-12
Greece
bps
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Portugal
mar.-00
mar.-01
mar.-02
mar.-03
mar.-04
mar.-05
mar.-06
mar.-07
mar.-08
mar.-09
mar.-10
mar.-11
mar.-12
Ireland
Public sector credit over private sector credit
Spread (RHS)

## Some facts

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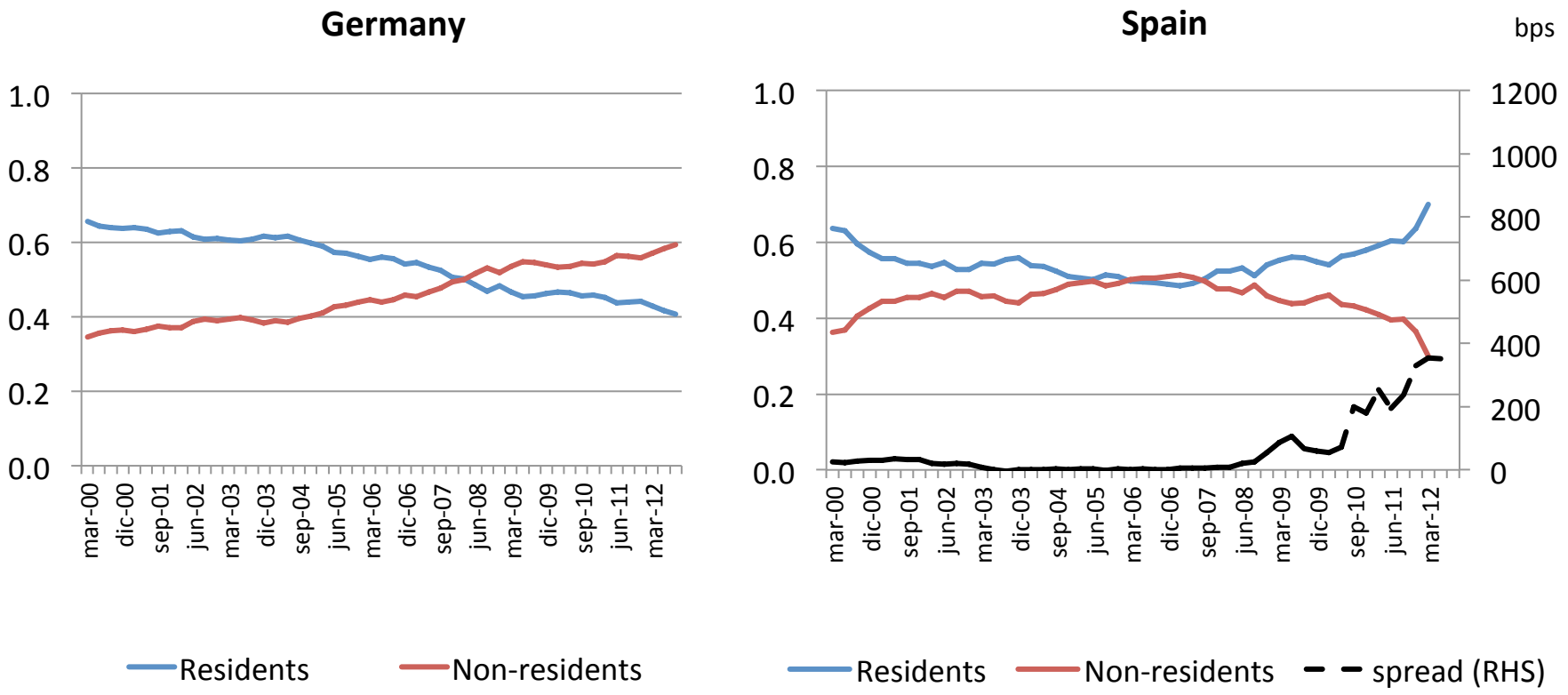
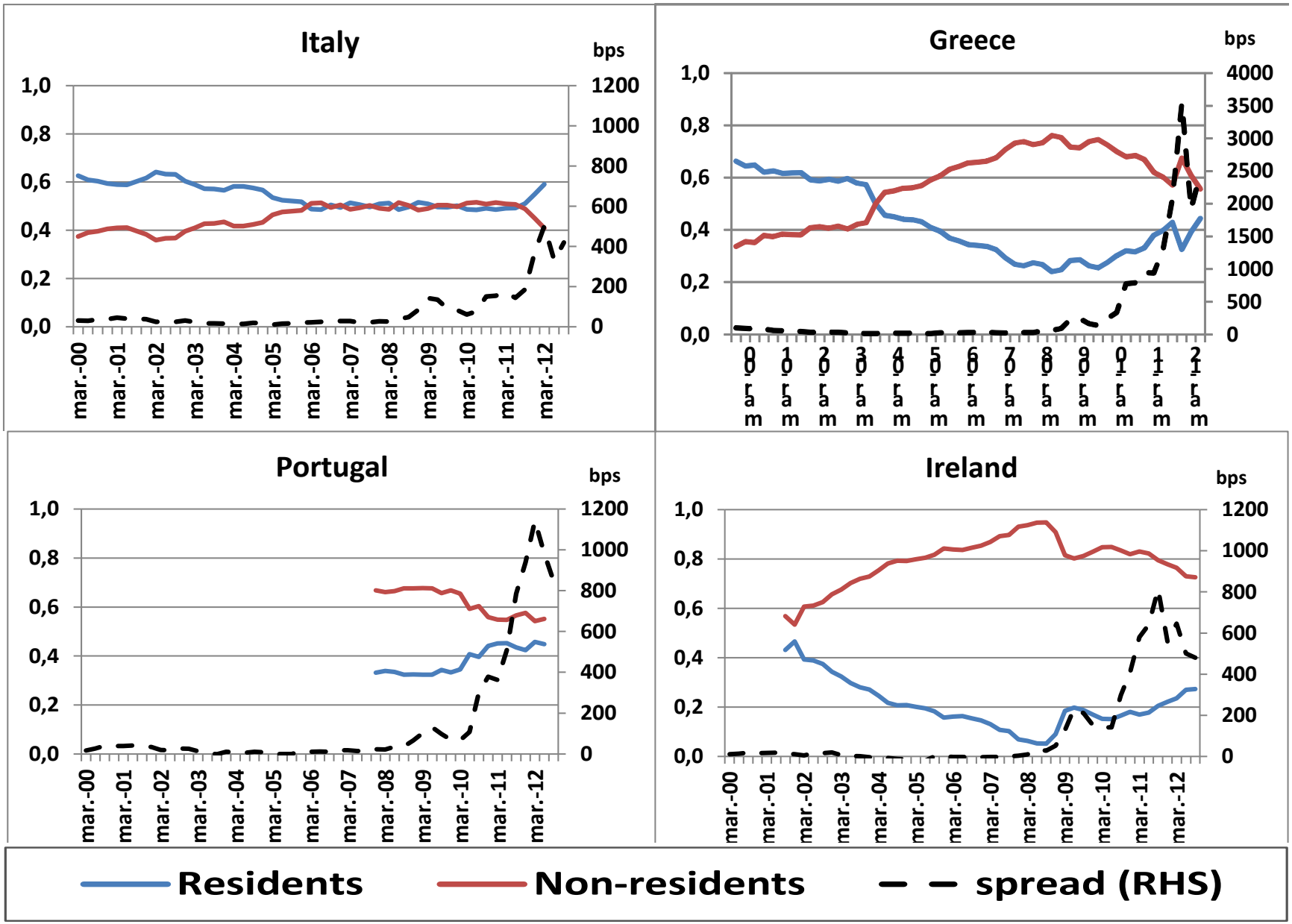
- Patterns of public debt holdings
  - sources: National Treasuries and Central Banks
  - in PIIGS sovereign debt holdings shifted from foreigners to domestic residents as spreads rose
  - in Germany they continued shifting to foreigners

# Sovereign debt holders: Germany vs. Spain




Italy
bps
1,0
0,8
0,6
0,4
0,2
0,0
1200
1000
800
600
400
200
0
mar.-00
mar.-01
mar.-02
mar.-03
mar.-04
mar.-05
mar.-06
mar.-07
mar.-08
mar.-09
mar.-10
mar.-11
mar.-12
Greece
bps
4000
3500
3000
2500
2000
1500
1000
500
0
Portugal
bps
Ireland
bps
Residents
Non-residents
spread (RHS)

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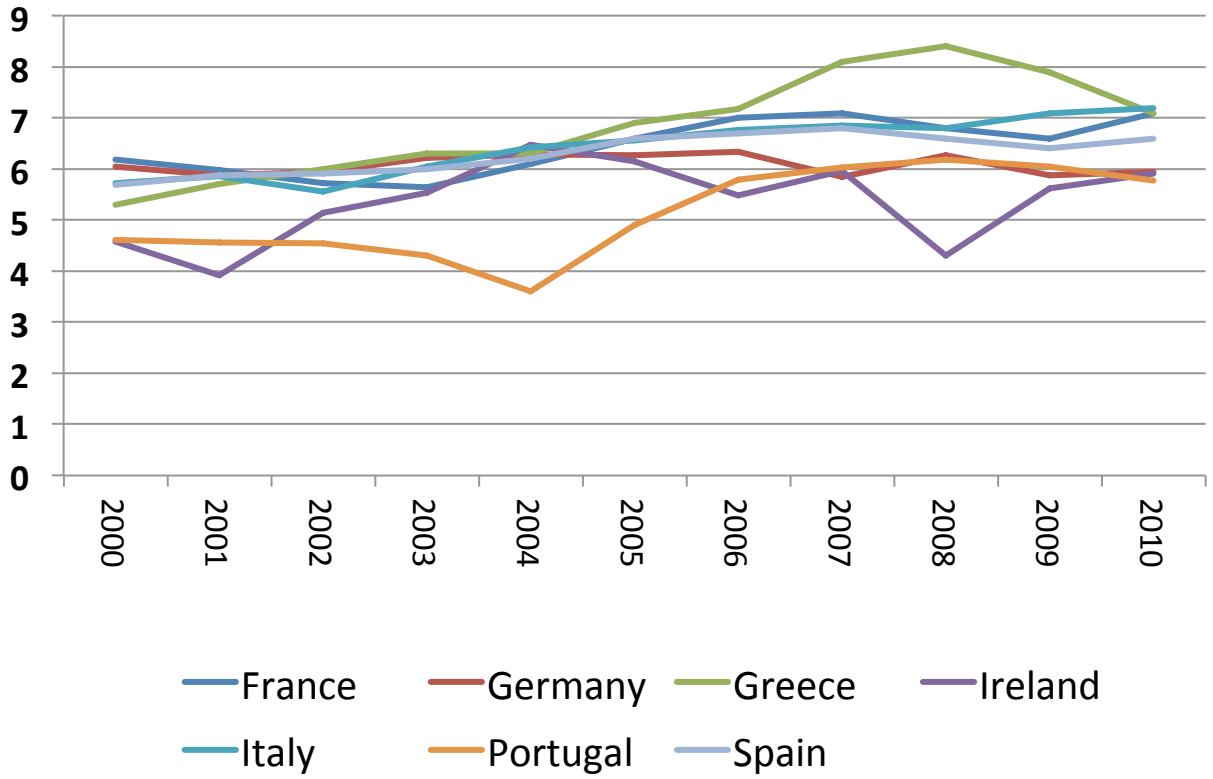
  - in PIIGS sovereign debt holdings shifted from foreigners to domestic residents as spreads rose
  - in Germany they continued shifting to foreigners
- Sovereign debt maturity
  - sources: OECD's Economic Outlook Database
  - in both PIIGS and Germany maturity has been stable at 6-7 years

# Average term to maturity



## Presentation of the model

- Sovereign debt, risk, and growth
  - multiple steady states and poverty traps
- Endogenous cost of default
  - multiple equilibria and rollover crises
- Role of maturity (preliminary)

## Model

- OLG: young and old, measure one
- Preferences: $1-\mu$ consume when young and $\mu$ maximizes expected consumption when old

$$U_t = E_t \{c_{t+1}\}$$

- Labor: young supplies one unit of labor inelastically
- Technology: Cobb-Douglas production function

$$f(k_t) = k_t^{\alpha}$$

  where $\alpha \in (0,1)$ and capital depreciates at rate $\delta \in (0,1)$

- Factor markets: competitive

$$w_t = (1-\alpha) \cdot k_t^{\alpha}$$
$$r_t = \alpha \cdot k_t^{\alpha-1} + 1 - \delta$$

- Young save fraction $s \equiv \mu \cdot (1-\alpha)$ of output

## Model

- Small open economy
  - international financial market (IFM) willing to borrow and lend at expected rate $\rho$
  - domestic residents save in capital and borrow from or lend to IFM

- Financial markets: domestic residents can pledge fraction $\phi \in (0, \rho)$ of capital stock

$$f_t \leq \frac{\phi \cdot k_{t+1}}{\rho}$$

  where $f_t$ denotes financing (assume $\phi = 0$ in this presentation)

- Government follows these rules of behavior
  - (i) issues only one-period debt
  - (ii) taxes old enough to keep debt burden constant at $d_t = d$
  - (iii) never defaults on debt held by domestic residents

## Model

- Government debt is traded in secondary markets
- Key question for evolution of economy: Who buys this debt?
  - depends on whether foreigners expect to be repaid or not
- Foreigners are repaid if secondary markets remain open when government debt matures
  - government might have incentives to impose capital controls

## Equilibrium

- If foreigners are repaid with probability 1
  - foreigners buy all government debt

$$R_{t+1} = \rho$$

  - young invest solely in domestic capital

$$k_{t+1} = k^1(k_t) \equiv \min\left\{ s \cdot k_t^{\alpha}, \left( \frac{\alpha}{\rho + \delta - 1} \right)^{\frac{1}{1-\alpha}} \right\}$$

  - old receive return on capital, are taxed to pay government debt, and consume

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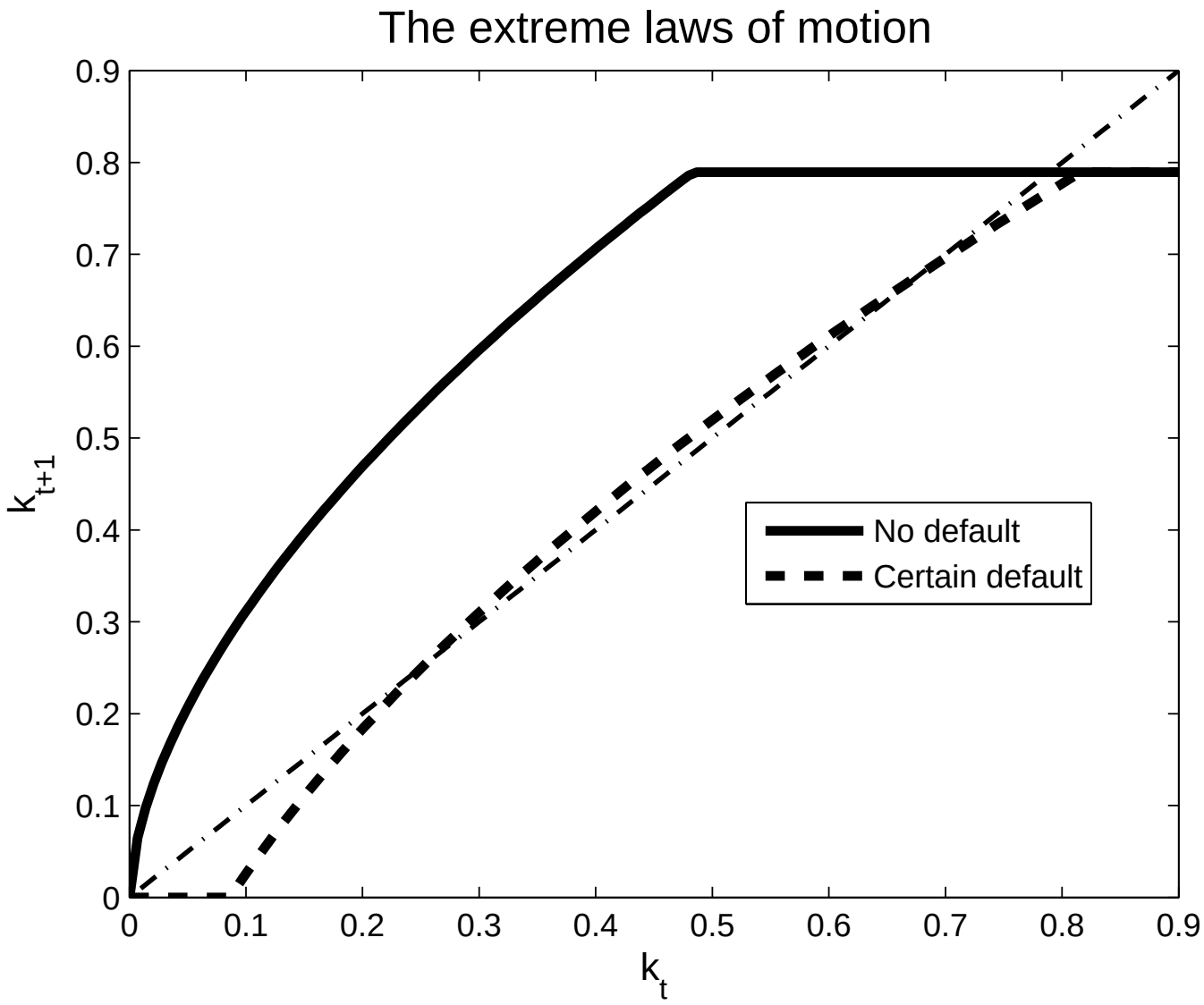
  - old receive return on capital, are taxed to pay government debt, and consume

- If foreigners are repaid with probability 0
  - foreigners do not buy any government debt
  - young invest in both domestic capital and government debt

$$k_{t+1} = k^0(k_t) \equiv \min\left\{ s \cdot k_t^{\alpha} - d, \left(\frac{\alpha}{\rho + \delta - 1}\right)^{\frac{1}{1-\alpha}} \right\}$$

$$R_{t+1} = \max\left\{ \alpha \cdot k_{t+1}^{\alpha-1} + 1 - \delta, \rho \right\} \geq \rho$$

  - old receive return on capital and government debt, are taxed to pay government debt, and consume


The extreme laws of motion
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
$k_{t+1}$
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
$k_t$
No default
Certain default

## Model with probabilistic default

- Foreigners are repaid with probability $\pi \in (0, 1)$
  - our interpretation: government can impose capital controls with probability $1 - \pi$

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- Foreigners are repaid with probability $\pi \in (0, 1)$
  - our interpretation: government can impose capital controls with probability $1 - \pi$
- Contractual interest rate depends on identity of marginal buyer
  - foreigners hold government debt if compensated for risk of default

$$R_t \geq \frac{\rho}{\pi}$$

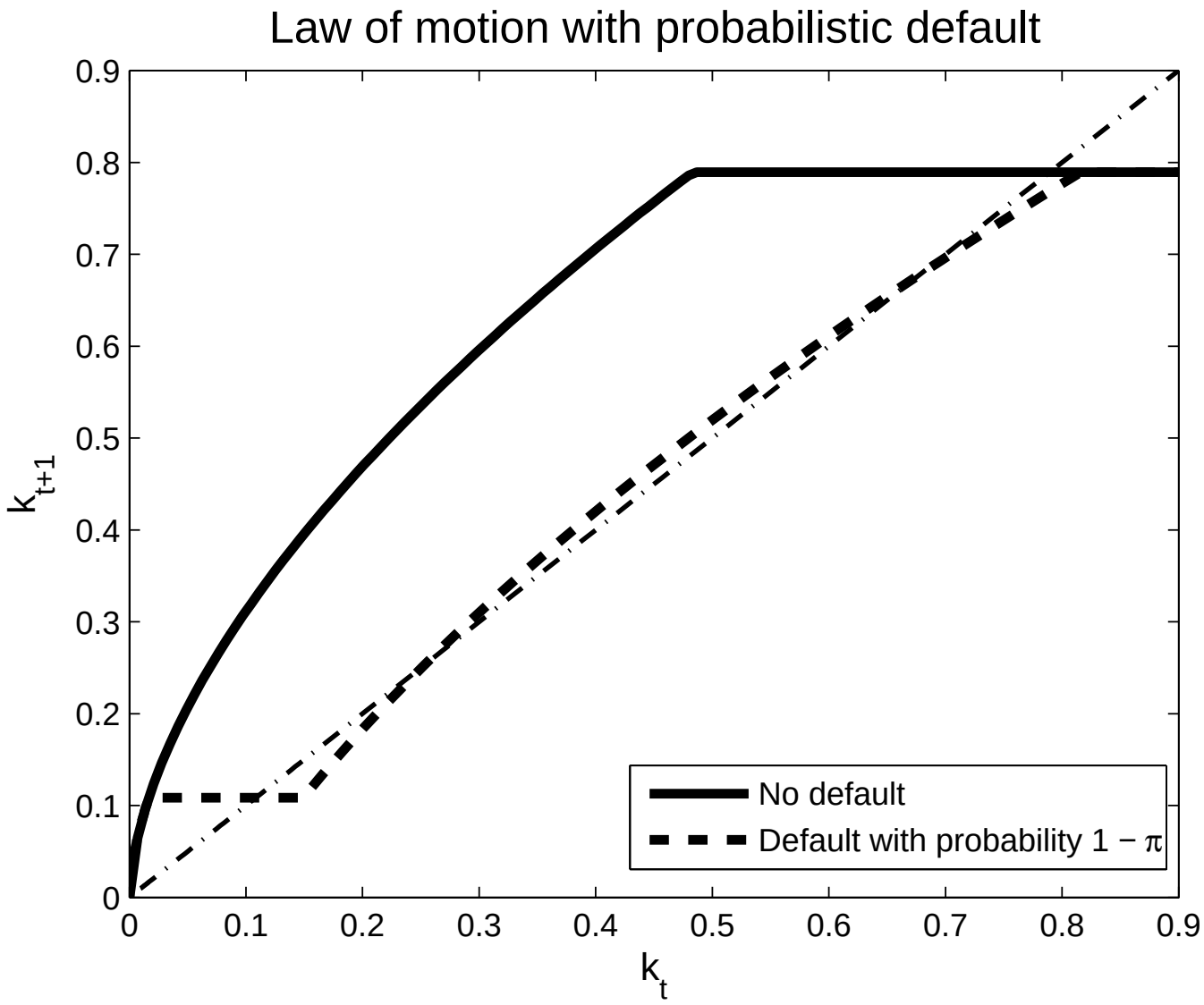
  - domestic residents hold government debt if compensated for foregone investment

$$R_t \geq \max\left\{\alpha \cdot k_{t+1}^{\alpha-1} + 1 - \delta, \rho\right\}$$

- Identity of marginal buyer depends on capital stock
- Secondary markets ex-ante imply that government cannot choose who to borrow from
  - debt is purchased by agents that value it more

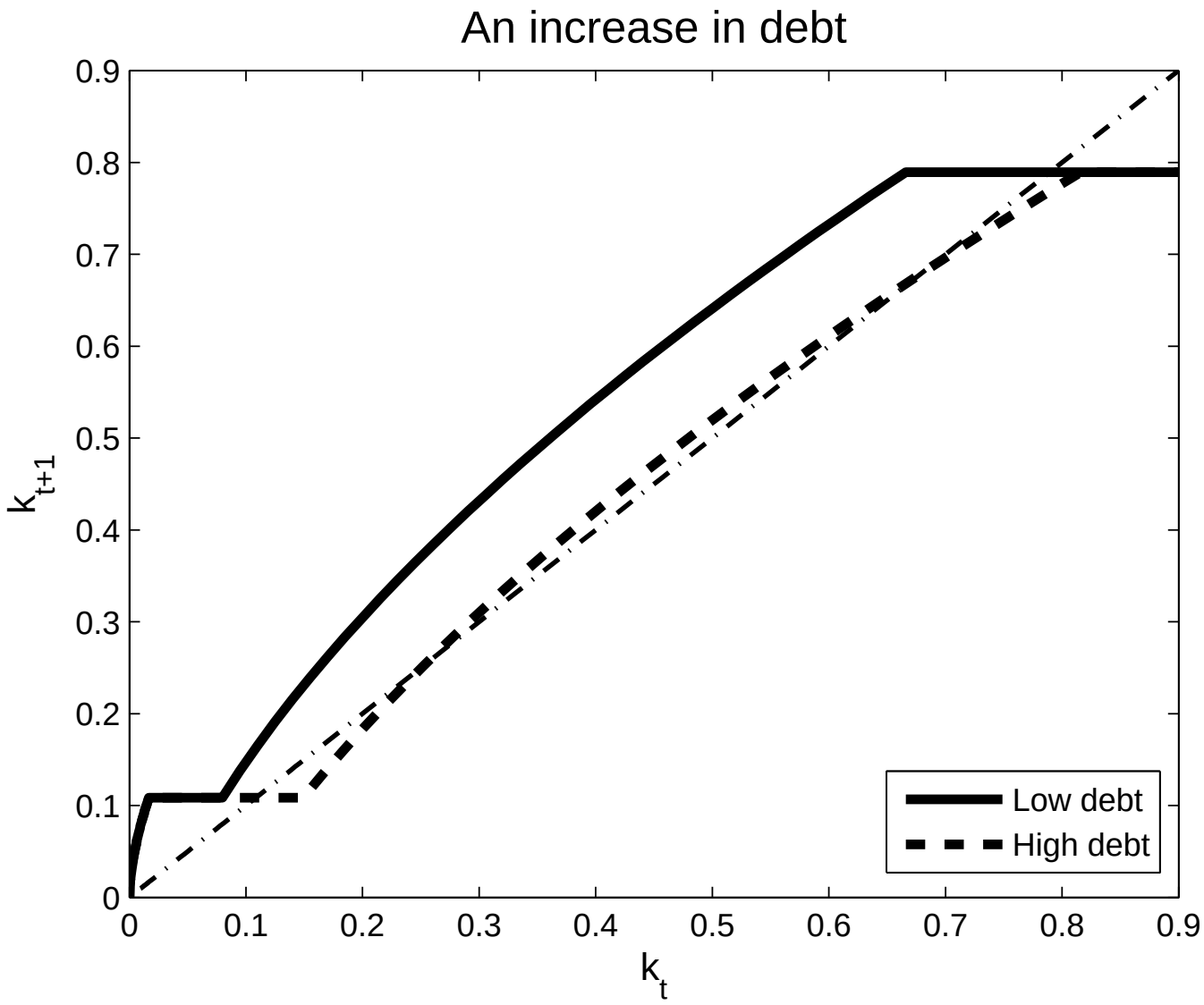
## Model with probabilistic default

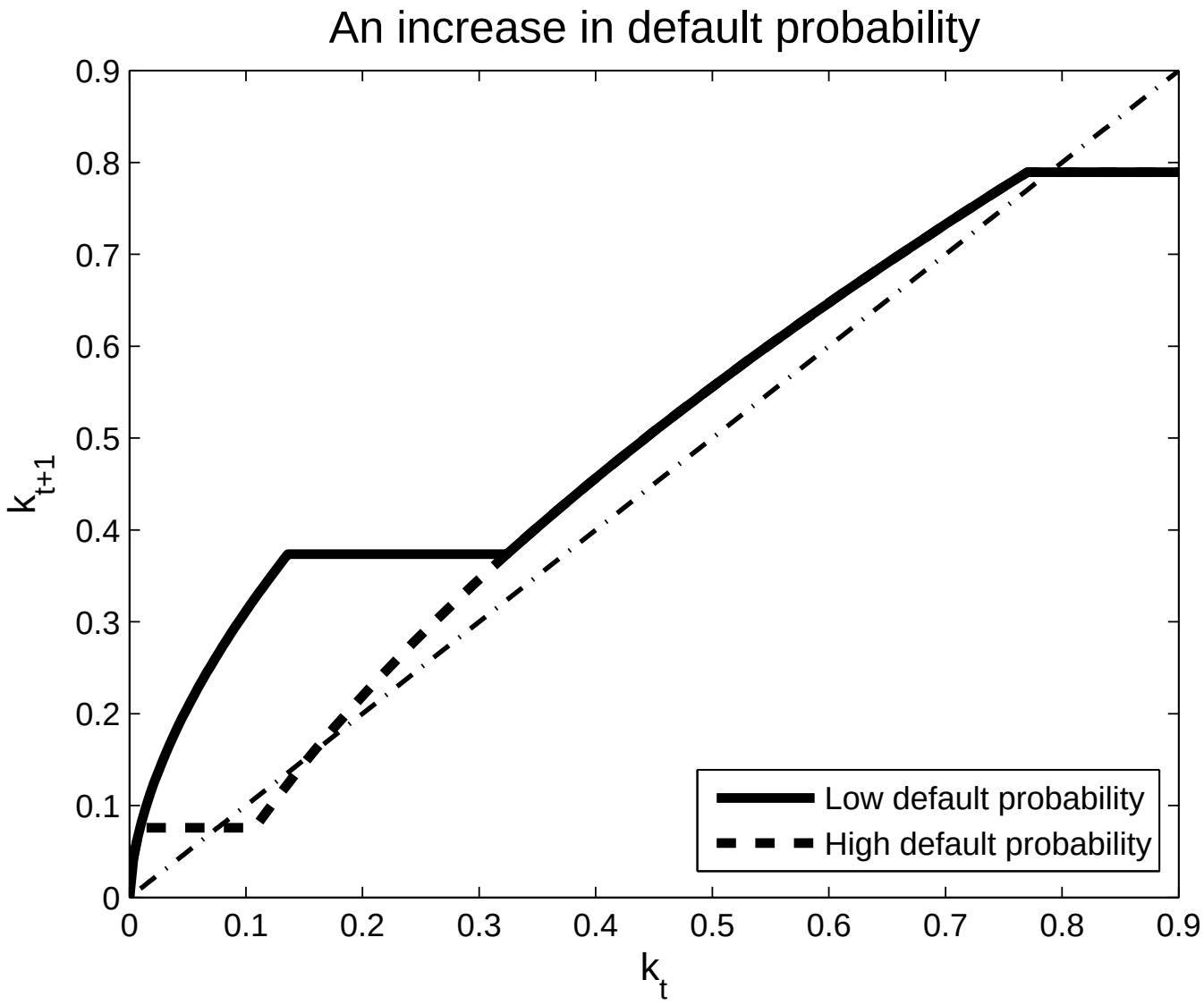
- Law of motion $k^{\pi}(k_t)$ characterized by three regions
- Region I: $k_t$ is low and its return high
  - domestic residents invest only in capital
  - all debt is purchased by IFM
  - $k_{t+1} = k^{1}(k_t)$
- Region II: $k_t$ and its return are intermediate
  - domestic residents invest in capital until return is equalized with (their) return on debt
  - some debt is purchased by IFM
  - $k_{t+1} = \left(\frac{\alpha \cdot \pi}{\rho - (1-\delta)\cdot \pi}\right)^{\frac{1}{1-\alpha}}$
- Region III: $k_t$ is high and its return is low
  - domestic residents invest in capital and purchase all debt
  - no debt is purchased by IFM
  - $k_{t+1} = k^{0}(k_t)$


Law of motion with probabilistic default
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
$k_{t+1}$
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
$k_t$
No default
Default with probability $1 - \pi$

## Model with probabilistic default

- Government can discriminate ex post but not ex ante (can make it more symmetric)
  - ex-post discrimination means debt is more valuable if held by domestic residents
  - ex-ante non-discrimination means government cannot prevent crowding out
- Can have multiple steady states and poverty traps
- Changes in debt and risk of default can have unexpected consequences


An increase in debt
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
$k_{t+1}$
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
$k_t$
Low debt
High debt


An increase in default probability
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
$k_{t+1}$
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
$k_t$
Low default probability
High default probability

## Model with cost of default

- Until now there was no cost of default
  - in reality: loss of reputation, sanctions, disruption of financial markets
- We now introduce cost of default
  - if government defaults on foreigners, old generation suffers a loss
- Deadweight loss
  - increases with capital stock: disruptions are more costly in absolute terms in a larger economy
  - increases with size of default: more effort undertaken to impose penalty
- In particular, we assume

$$\text{cost of default} = \lambda \cdot R_{t+1} \cdot d^F_{t+1} \cdot k_{t+1}$$

## Model with cost of default

- Cost of default may sustain "optimistic equilibrium"
  - if $\lambda \cdot R_{t+1} \cdot d^F_{t+1} \cdot k_{t+1} \geq R_{t+1} \cdot d^F_{t+1} \Leftrightarrow k_{t+1} \geq 1/\lambda$ government repays foreigners
- If repayment is expected with probability 1

$$R_{t+1} = \rho \quad \text{and} \quad d^F_{t+1} = d$$

$$k_{t+1} = k^1(k_t)$$

and expectations are validated if

$$k_t \geq \bar{k}^O \equiv \begin{cases} \min\left\{k : k^1(k) = 1/\lambda\right\} & \text{if } \lambda \geq 1/k^* \\ \infty & \text{if } \lambda < 1/k^* \end{cases} \quad \text{where} \quad k^* = \left(\frac{\alpha}{\rho + \delta - 1}\right)^{\frac{1}{1-\alpha}}$$

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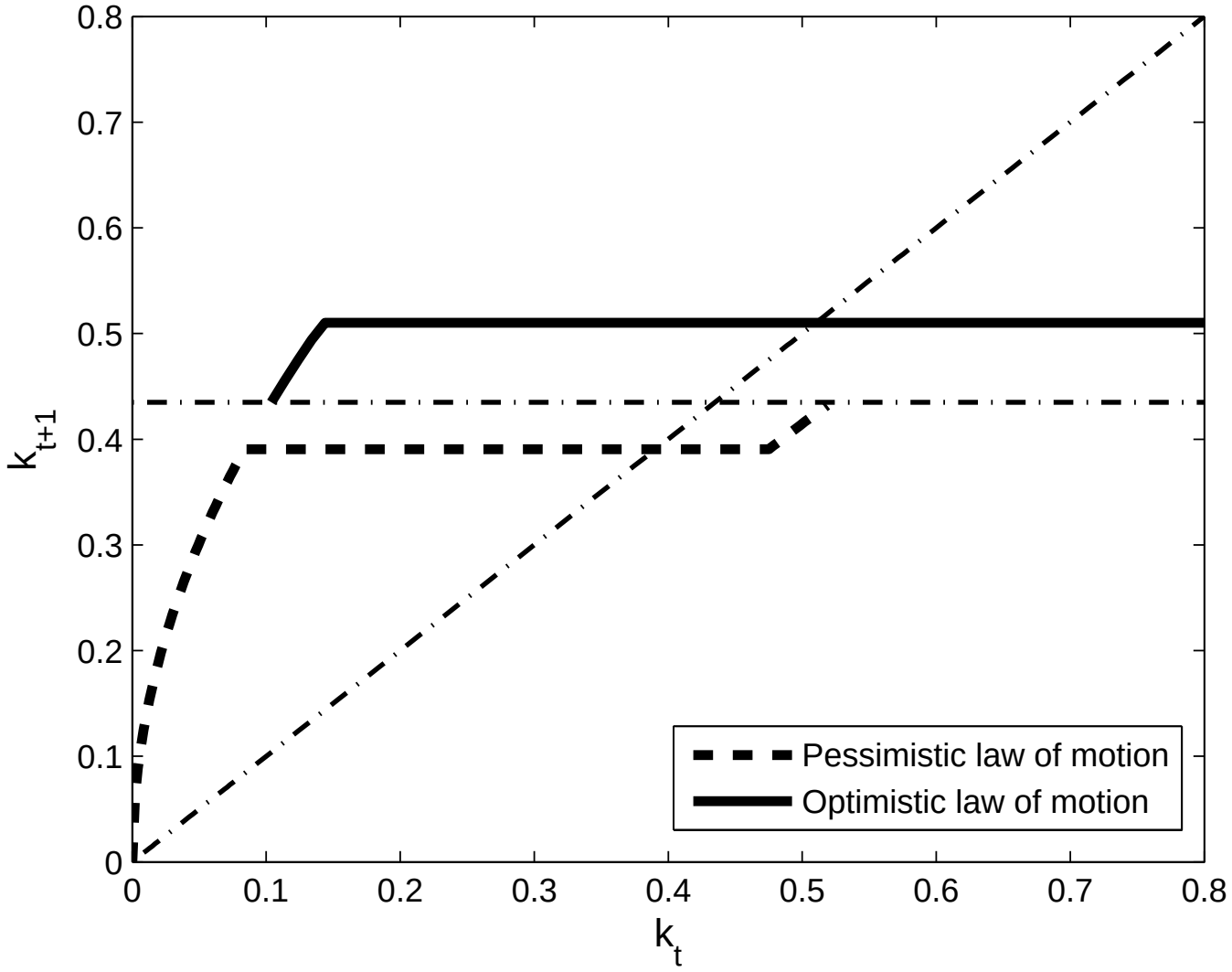
- In this equilibrium
  - expect repayment $\longrightarrow$ debt not attractive to domestic residents $\longrightarrow$ high investment $\longrightarrow$
    $\longrightarrow$ high capital stock $\longrightarrow$ repayment takes place

Figure 13: Optimistic and pessimistic laws of motion



## Model with cost of default

- Despite cost of default there may be a "pessimistic equilibrium"
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- If repayment is expected with probability $\pi$

$$R_{t+1} \in \left[\rho, \frac{\rho}{\pi}\right] \quad \text{and} \quad d^F_{t+1} \in [0, d]$$

$$k_{t+1} = k^{\pi}(k_t)$$

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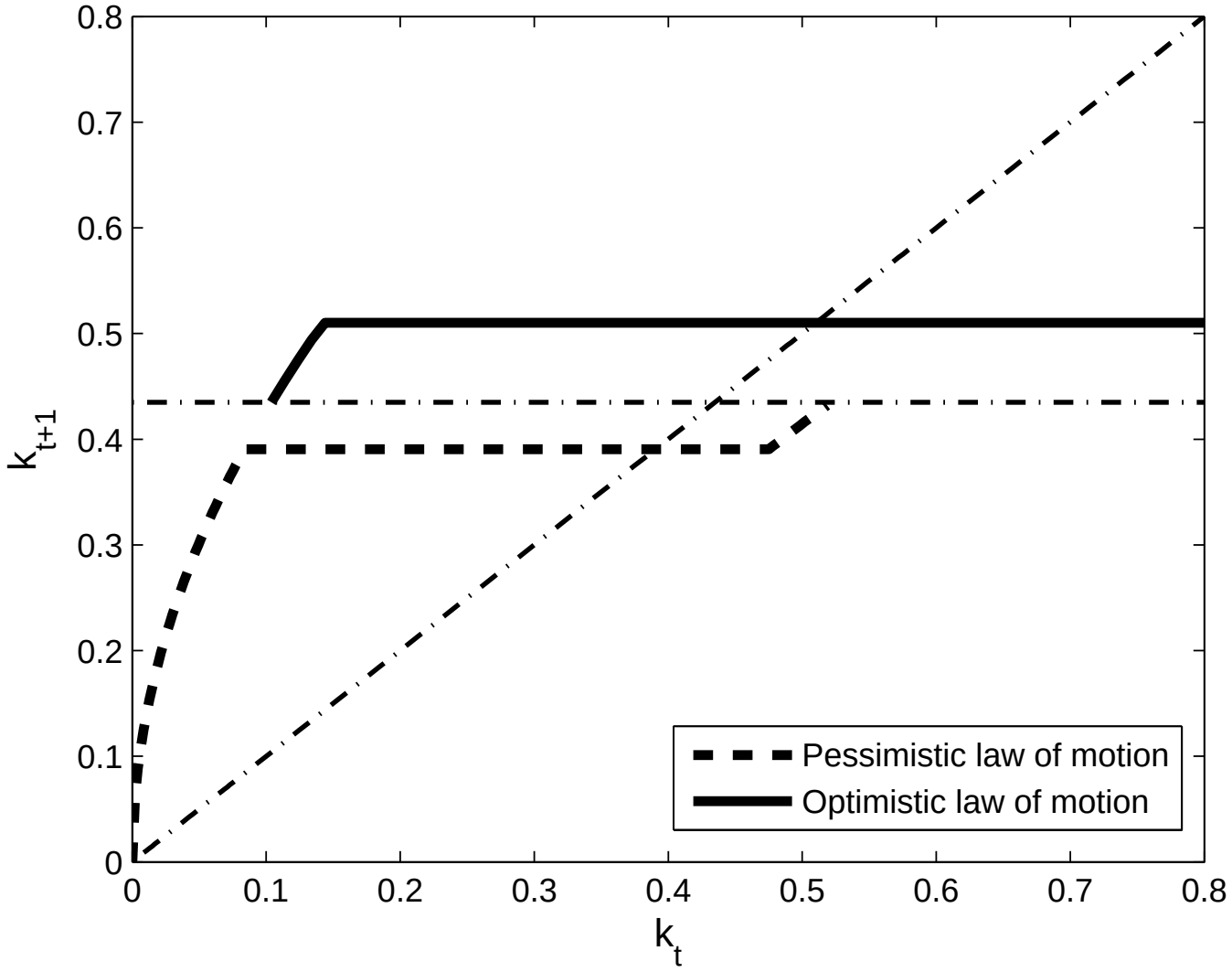
- In this equilibrium
  - expect default $\longrightarrow$ debt attractive to domestic residents $\longrightarrow$ low investment $\longrightarrow$
    $\longrightarrow$ low capital stock $\longrightarrow$ default takes place

Figure 13: Optimistic and pessimistic laws of motion



## Model with cost of default

- Since $k^{\pi}(k) \leq k^{1}(k)$ for all $k$, it follows that

$$\bar{k}^{P} \geq \bar{k}^{O}$$

- Both optimistic and pessimistic equilibria exist if

$$k_t \in \left[\bar{k}^{O}, \bar{k}^{P}\right]$$

- A self-fulfilling crisis leads to
  - higher sovereign spreads
  - fraction of debt held domestically increases
  - domestic resources shift from investment to government debt
  - lower investment and growth

## Maturity structure (preliminary discussion)

- Now government can issue debt of any maturity
- Assume
  - with probability $1 - \pi$ government can default on all outstanding debt held by foreigners
  - cost of default is proportional to market value of defaulted debt at end of previous period
- Conjecture: maturity structure makes no difference
  - optimistic and pessimistic equilibria exist for same values of $k_t$ as with one-period debt
  - laws of motion in both equilibria are the same as with one-period debt

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- Why?
  - with secondary markets foreigners can sell both maturing and non-maturing debt to domestic residents
  - size of "run" is independent of maturity structure
  - secondary markets make long-term debt effectively short-term with respect to rollover crises

## Conclusions

- Facts of recent European crisis
  - higher spreads
  - sovereign debt holdings shifted from foreigners to domestic residents
  - bank credit shifted from corporate and consumers to government
  - debt dynamics driven by higher spreads and lower growth
- Portfolio reallocation
  - might seem puzzling and contrary to logic of optimal diversification
  - but is natural in models of sovereign risk with secondary markets
- In this paper, crisis triggered by
  - higher debt
  - higher probability of capital controls
  - multiple equilibria
- Secondary markets constrain governments. If they operate
  - at time of maturity: negative but ex-ante positive (reduce sovereign risk)
  - before maturity: negative (prevent market segmentation and lead to investment crowding out)
- Next,
  - formal analysis of maturity structure, contagion, and bailouts